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ABSTRACT

This paper reviews research on the use of white sounds (relaxing background sounds such as water or ocean waves) with people in a variety of situations and in the education of children with learning disabilities. Applications reported include the following: toilet-training toddlers; encouraging sleep in neonates; inducing relaxation in dental patients and patients with diagnoses of suspected myocardial infarction; inducing sleep in young adults; facilitating mathematical problem solving by students; and encouraging relaxation in cancer, heart, and post-surgery patients. The use of white sounds in a classroom setting with eight children having a variety of learning disabilities is then reported. Results strongly support the use of white sounds as a non-evasive, highly effective way to mask out all extemporaneous stimuli for children with reading difficulties or attention deficit hyperactivity disorder. (Contains 15 references.) (DB)

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A Retrospect of the History of White Sounds and Applications in the Dental, Medical and Educational Communities

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This paper is concerned with the emergence of white sounds as a tool for medical recovery and its crossover application in the education of the learning disabled child. This paper will chart the history of white sounds in medical and classroom settings, concluding with special emphasis on learning disabled children, especially Attention Deficit Hyperactivity Disorder (ADHD).

As the accumulation of all color is the white color, the accumulation of all sounds is the white sound. White sounds are usually some form of water or ocean sounds, often with a background of one or two woodwinds, played at low (60 dB or less) decibel levels. For the purposes of this paper the term white noise will refer to high decibel (70 dB +) levels. According to the American Academy of Otolaryngology decibel ratings of 60 dB are equivalent to normal conversation and 70 dB are equivalent to busy traffic.

The first active recorded use of white sounds was by mothers potty-training their toddlers. Mothers would put their children on the potty chair and turn on the sink tap. The sound of running water would elicit urination from the toddler. It was thought that the toddler was, at a

subconscious level, trying to imitate the sound of the tinkling water. However, this was proven not to be the case.

In studies done in the late 1980s it was proven that white sounds stimulate the pleasure center of the brain causing relaxation. In the case of the toddler, the white sounds (i.e. the sound of running water) not only stimulated the pleasure center but caused relaxation of the external sphincter muscles. This in turn caused the release of urine.

In the late 1980s, two groups of neonates, between two and seven days old were studied in a randomised trial. Starting with the theory that recordings of intrauterine sounds calm babies, it was hypothesized that a neonate would fall asleep faster, and sleep more soundly for a longer duration while in the presence of white noise.

A battery operated commercial white sound device was placed in the crib between twelve and twenty inches from the neonates head. It was either turned on or left off according to randomised cards in envelopes. Each neonate was continuously observed by one examiner for a period of five minutes. The examiner recorded if and how quickly the neonate fell asleep.

A continuous record of heart rate was made using ECG electrodes (attached to the neonates chest) and an FM7 monitor. The white sounds were perceived at 72.5 dB for thirty seconds and 67 dB for the remaining time.

A couple fascinating effects resulted. Sixteen of the first group of twenty neonates fell asleep within four and a half minutes after the device was turned on. Only five went to sleep without the introduction of the white sounds.

More than three times the number of neonates fell asleep with the white sounds than number of neonates without the benefit of the white sounds. Of the twenty neonates not originally exposed to white sounds 73% fell asleep within two minutes after the white sounds were turned on.

The heart rates on the monitored neonates dropped from 120-180 to 110-120 beats per minute. This is indicative of a deeper more relaxed sleep. These results show that the likelihood of a neonate to full asleep quickly and sleep more soundly when exposed to white sounds is increased as much as 80% over the unexposed neonate. Also the neonate exposed to white sounds slept an average of 20% longer than the unexposed neonate.

A curious side note is that white sounds promoted sleep only in neonates who were not hungry. Two neonates that did not initially respond to white sounds settled to sleep quickly after being feed. Also two neonates in the unexposed group refused to settle when the white sounds were turned on until they were fed.

White sounds will never deprive neonates of feeds but can be a useful, inexpensive, and most beneficial way for a mother to settle a fussy neonate after a feed.

Many studies have been done in the last seven or eight years on the use of both white sounds and white noise. The results have been fairly consistent and conclusive. White sounds promote feelings of pleasure and relaxation while white noise increases stress and anxiety.

Studies were done with patients in dental offices using white sound tapes. Half the patients were given headsets and they listened to white sounds (also refered to as synthetic silence). The other half were not. The patients were chosen because they all exhibited high anxiety. It was discovered that the group listening to white sounds was able to tune out

the sounds of dental drills and relax. Further, they required less medication and less time in the chair than did the patients without the white sounds.

A combined study was done in the Cardiac Care Unit (CCU) of three Midwest hospitals. This study involved 75 patients with diagnoses of suspected myocardial infarction. One third were given music tapes and a headset, one third were given white sound tapes and a headset, and the last third were given thirty minutes of uninterrupted bedrest. All three groups were tested for thirty minutes. They all relaxed and their anxieties and tensions dropped. However, even though the two groups with headsets were often interrupted and the third group was not, the white sounds group was as relaxed as the uninterrupted group and much more relaxed than the music group.

Pavlov once wrote that all monotonous stimuli resulted in drowsiness and sleep. Irene Daum M.S.C., J.P. Leonard Ph.D., and F.J. Hehl Ph.D. of the University of Dusseldorf did an experiment to prove or disprove Pavlov. They hired sixty male students eighteen to thirty-two years of age. After days of careful preparation the students arrived for the experiment. EEG and EOG electrodes were attached. Each

student was taken to a bed in a soundproof room adjacent to the room where the equipment was kept. Each student was told to lie down and try to rest for about forty minutes. It did not matter whether or not he fell asleep.

White sounds were piped to half the students and the other half got silence. Fifty-five percent of all the students fell asleep. All the white sound recipients fell asleep and five percent of the students receiving silence fell asleep. The white sounds stimulated the pleasure centers causing total relaxation with the end result of sleep.

In 1988 a study was done at the University of Southern Alabama. This study tested the effects of color, white sounds, and white noise on the ability to solve computer generated math problems. This study involved one hundred and one women and twenty-two men. They were divided into four unequal groups.

The students attempted to solve problems randomly generated on the computer. This was a mental exercise done with five different colors of light bulbs shining on the screen. Also three levels of white sounds and two of white

press the correct response button. Each student was tested under one level of white sound (50 dB), two of white noise (70 and 90 dB), and one period of silence.

The results again proved that the use of white sounds increased detection of stimuli and correct responses while white noise significantly reduced detection and correct responses. These results agree with the hypothesis the level of sound holds a direct correlation with the success of task.

There has been much research done in hospital and clinical settings. In cancer, heart and post surgery patients it has been used to improve a patients' ability to relax by stimulating the pleasure center of the brain. This in turn causes a release of anxieties, greater control over pain, a reduction in pain medication and a shorter recovery time.

There has also been considerable research done with students, testing the ability to do mathematics and other tasks with both white sound and white noise. This has caused, as with any subject, some controversy. For example, in studies by Hockey and Hamilton, Wilding and Mohindra, Daee and Wilding, and Breen-Lewis and Wilding white sounds benefit sequential information in learning.

However research by Davies and Jones and Salemie and Wittersheim produced the opposite results. Both studies suggested that the use of white sounds encouraged subjects to employ a more superficial form of learning strategies.

Schwartz suggested the white sounds actually improved memory for physical features but harmed the process of semantic features in written information. Smith and Broadbent, on the other hand found white sounds did not interact with the physical semantic dimension in memory for written information but did interact with task priority and sometimes with retrieval of information.

This conflict prompted more research with white sounds and white noise. In a most fascinating study conducted by Hartley, it was proven that white sounds encouraged the subjects to use what ever strategies were pleasurable to themselves. While this study did show that subjects could be identified by the strategy they chose, it also proved that white sounds did not reinforce the use of the preferred strategy. It rather improved performance of verbal strategies but hindered performance of spatial strategies.

noise in the background were utilized. The problems were presented at one to three second intervals.

The results showed more correct answers at the three second interval than at the one second interval. The colors did not show a significantly different result in problems solved correctly. There was an important difference reported, though, between the levels of white sounds and white noise. While women had a greater loss of problem solving ability when exposed to white noise than men, women also had a higher rate of problem solving than men when exposed to white sounds.

There have been many studies done on the effects of sound on performance. There was a particularly interesting study done at Regis College in Denver Colorado by Linda A. Britton and Eugene R. Delay. Thirty undergraduates (fifteen male and fifteen female) between eighteen and twenty-four years old were chosen.

Each student was seated in a very small chamber at a white table, with a response lever and four red stimulus lights. A speaker was centered, on the wall, directly behind the students' head. The student was to pull the lever and

The consensus was reached that the major benefits of white sounds depends on whether the subject is preforming a verbal or spatial task. The work (or school) setting can be very beneficial with verbally presented instructions. Also it would be detrimental if the only task is looking at pictures.

This author did research to ascertain the value of white sounds in a classroom setting. She worked with eight children between the ages of seven and nine. There were three boys, two eight and one nine years old, one seven year old boy and five eight year old children presenting (in order) severe reading difficulties, perceptual and phonic problems, and mathematical dysfunction.

The two eight year old boys were of Hispanic descent as was the nine year old. Michael and David, (all the childrens' names have been changed to protect anonymity) both age eight, were tested one and a half years behind their peers in reading ability. They were seen three times a week for ten weeks in one hour sessions.

The first two weeks there was little improvement and it was not a pleasurable experience for the boys. Starting the third week white sounds were introduced for one half hour in each session. This became a pleasurable time for Michael and David. Since they had improved measurably it was decided to have the white sounds on during the whole sessions. After three more weeks they advanced from beginner books to Dr. Seuss. By the end of the sessions they had advanced a full grade and could read any Dr. Seuss book with 99% accuracy.

Dr. Seuss books were chosen because they are filled with made-up words that must be sounded out. This author highly recommends Dr. Seuss books for any child with reading and\or phonic problems because they are filled with made-up words encouraging the child to sound them out.

Dr. Seuss writes books rich in lyrical quality and rhymings. Also these books advance from very simple (Hop On Pop) to very difficult (To Think That I Saw It On Mulberry Street). Dr. Seuss challenges children in a most non-threatening and pleasurable manner.

Eight year old Jose was seen twice a week for ten weeks in private sessions. Also presented a year and a half behind

his peers. He was belligerent, uncooperative and resented having to come to his sessions. He was extremely tense in the beginning and white sounds instituted immediately to encourage him to relax. Even so it took a full four weeks to achieve some release of tension and gain his trust.

His problem was twofold. English was his second language. Also his self-esteem was very low. His peers taunted him because he could barely read any English. He made little progress until he lowered his defenses. As his reading improved, his self-esteem escalated. By the end of the ten weeks he could read most Dr. Seuss books with about 75% accuracy. He improved about one half a grade but considering his limited English proficiency this is excellent progress.

The math group consisted of five eight year olds. There were two Philippino children (Kia and Bic), one of African descent (Twanda), one Irish boy (Shaun) and one Hispanic boy (Paublo). All five children worked together as a small group one hour a day for seven weeks. All five posed severe difficulties with using numbers and were unable to solve even the most basic mathematical computations.

The first two weeks all five received intense visual, tactical, and audio instruction but made very little progress. The beginning of the third week white sounds were added. The children found this pleasurable and asked for them each time they came in.

Still progress was very slow, although there was a marked improvement in retention. In the beginning they could not remember anything from one session to the next. However, toward the end they remembered well enough from one session to the next that they were able to build some new skills instead of a constant re-enforcement of the old.

Jimmy was seven and came to a psychiatric clinic for children with learning disorders. His initial screening showed his was a difficult pregnancy and birth. He started speech at 17 months and walking at 14 months. His father and maternal grandmother were diagnosed dyslexic. His parents were divorced and he lived with his mother, step-father, and older brother. He was a very happy child and was a hard worker.

He was tested and diagnosed dyslexic and presented a serious reading problem in that he had very little concept of

the sounds of letters. He came for three hours, one night a week, for fourteen weeks. The sessions were hard but he always gave his best effort.

After five weeks of intense phonics and letter sound mastery he was given a book to read. It was the Dr. Seuss book "Hop On Pop". He read a few pages very haltingly and with great difficulty. the white sounds were turned on and he was asked to read the same passage again. He read beautifully. It was smooth and there was no hint of hesitation.

Later listening to the recording of the session, this author realized if she had not been watching Jimmy read she would not have believed it was the same child reading both passages. The difference was that dramatic!

By the end of the fourteen weeks Jimmy had a good grasp of phonics and could read any Dr. Seuss book with 99% accuracy with the white sounds playing. He was given a white sounds tape to use at home after the amazing results of the fifth session and used it faithfully whenever he did his homework. By the end of the sessions his report card showed marked improvement in all areas.

Roscoe A. Dykman, PhD, Peggy T. Ackerman, MA, Phillip J. Holcomb, MA, and Yvonne Boudreau, BA, put together a most interesting paper comparing the psychophysiological functions of minimal brain dysfunction, or MBD, (used to describe normally intelligent children who were LD, ADD, or both).

These children were tested utilizing autonomic measurements such heart rate (HR), skin conductance (SC) level (mainly based on sweat glands), galvanic skin response (GSR), and respiration (recorded on a pneumograph). Other responses noted were pulsation of blood vessels in the fingers, (finger pulse), muscle action potentials and skin temperature.

Three varieties of attention were addressed. They were: orienting, attention-in/attention-out, and conscious processing. These catagories were further branched into sub-categories including arousal, automatic and conscious attention, intention, the theoretical consideration of excitation-inhibition.

The authors presented the hypothesis hyperactive children tend to be overaroused whereas non-hyperactive LD children are underaroused. The authors went into some detail

explaining that LD children have higher basal levels (HR and SC) than "normal" children but demonstrated no difference from that of hyperactive children.

It was further postulated that hyperactive children need higher than normal levels of arousal to respond efficiently. LD children, however, are at least as aroused as "normal" children. But LD children do not physiologically alter to the same degree when given stimuli and the optimum range for this altering process is considerably narrower. This means that LD children have a much smaller learning window than "normal" children. This significantly reduces the ability to assimilate and retain information.

LD children have been found to respond more slowly and are unable to retain readiness beyond encoding time. This means LD children require considerably more stimuli to learn and they lose interest much more quickly. The optimum strategies would include a decrease in going from pre-stimulus to stimulus and increasing rehearsal and recall.

Since the capacity for conscious attention is very limited, LD children should attend to only one short instruction at a time. The major difficulty of the LD child

lies in the inability to sustain attention. The LD child requires greater feedback and more stimulation than the "normal" child.

ADHD "affects as many as three and one half million American youngsters, or up to 5% of those under eighteen. It is two to three times as likely to be diagnosed in boys as in girls. ... One-third to two-thirds of ADHD kids continue to have symptoms as adults." (Time, July 18, 1994)

In 1902 a pediatrician, Dr. George Still, published a detailed account of twenty of his patients. He described them as "'passionate,' defiant, spiteful, and lacking 'inhibitory volition.'" (Time, July 18, 1994) Dr. Still disregarded the theory of the day. It was his hypothesis these symptoms were not attributable to bad parenting. Instead he suspected brain injury.

In the years following the 1917-18 viral encephalitis epidemic so many children exhibited the symptoms carefully documented by Dr. Still, doctors were forced to re-evaluate his suspicions. In the 1940s a name was finally attached to that group of symptoms - minimal brain damage (MBD). In the 1950s term 'minimal brain damage' was replaced with 'minimal

brain dysfuction'. The idea of damage to the brain was once again abandoned.

In 1937 an article was published which documented the use of stimulants (amphetamines), on children exhibiting MBD symptoms. Instead of increasing the hyperactivity, it elicited the unexpected result of a calming effect on the children. As of the date of this article, why this is so is still unknown.

Methylphenidate (Ritlin), is the most commonly prescribed medication for ADHD and since 1990 the number of prescriptions has increased more than 390%! It has been conjectured the reason ADHD (once thought to be only a bad a parenting problem) is, as Dr. Still suspected, a specific brain injury.

Gray theorized within the human body there are two behavioral systems - the behavioral inhibition system (BIS) and the behavioral activation system (BAS). The BIS processes signals associated with punishment while the BAS processes signals associated with reward.

The septohippocampal system of the brain is thought to be the neurophysiologic mesolimbic system forms the substrate of the BAS when the release of norepinephrine stimulates the septohippocampus the body becomes highly sensitive to punishment and, conversely, when the mesolimbic system is stimulated by dopaminergic inputs the body sensitivity to reward is increased accordingly.

Research has shown a child with damage to the septohippocampus manifests a marked decrease in BIS. This means the child with ADHD is unable to effect a direct correlation of action to punishment. The child with ADHD will demonstrate a lack of inhibition to stimuli which have been linked with punishment in the past. For this reason punishment is not a viable tool in ADHD management.

Conversely, a child with ADHD and unsocialized conduct disorder (UCD) will demonstrate heightened BAS activity. A child with ADHD/UCD tends to be "reward-dominant" leading to reward seeking behavior even to stimuli which indicate punishment. This also presents serious problems in ADHD management.

Children with ADHD are easily distracted by extemporaneous stimuli (the ticking of the clock, a siren in the distant, the sound of a pencil sharpener etc). Children with ADHD are usually of above average intelligence. They attempt to process all the stimuli around them at once. They attempt to assimilate all the stimuli around them at once. This effects a type of "brain overload". "Brain overload" is manifested by difficult to control behavior.

The use of white sounds is a non-evasive highly effective way to mask out all extemporaneous stimuli. This allows the child with ADHD to focus on task. It also gives the child greater control over his/her behavior. This control is essential in promoting self-esteem and creating an environment conducive to academic success.

White sounds can be transmitted through the use of earphones. However, many teachers do not want to single out a particular child or expend the small amount of time it takes to assist the child. It would be perfectly acceptable to allow the whole class to enjoy the white sounds.

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